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Original Article

Comparative Analysis Of Blue Value Estimation Of Starch Extracted From *Ipomea Batatas* L. (Lam.) And *Amorphophallus Paeoniifolius* (Dennst.) Nicolson Tubers

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ABSTRACT

Starch is a renewable and biodegradable polymer whose functional properties are strongly influenced by its molecular composition, particularly the relative characteristics of amylose and amylopectin. Blue value estimation based on iodine-starch complex formation gives a simple spectrophotometric approach for evaluating the iodine-binding characteristics of starch. This study is aimed to evaluate blue values Comparison of the *Amorphophallus paeoniifolius* and *Ipomoea batatas* starch extract. Starch was extracted from 500 g of fresh tuber material using an aqueous sedimentation method. The starch yield was subjected to iodine-spectrophotometric analysis, and absorbance was measured at 620 nm. *I. batatas* yielded 146 g of dry starch, which is 29.2%, whereas *A. paeoniifolius* yielded 122 g, corresponding to a yield of 24.4%. The mean blue value of *A. paeoniifolius* starch found is 0.435 ± 0.072, which is comparatively higher than that of mean values of *I. batatas* (0.226 ± 0.003). The higher blue value indicates greater iodine-binding capacity and suggests amylose-associated characteristics differences between two starches. Starch yield and blue value showed contrasting trends observed in starch yield and blue value, that indicates the starch yield does not correspond to its molecular characteristics. These findings describe preliminary comparative information of these two tuber starches and further support evaluation of direct quantification of amylose and additional characterization of physiological parameters.

Keywords: Blue value, Amylose, Starch, *Amorphophallus paeoniifolius, Ipomoea batatas,* Iodine-starch complex.

INTRODUCTION

Starch is one of the most abundant naturally occurring polysaccharides and the primary carbohydrate reserve in higher plants. (Vardhan et al., 2025). It is renewable, biodegradable, non-toxic, and cost-effective (Ogunsona et al., 2018), because of that it is gaining popularity for use in the food, pharmaceutical (Chakraborty et al., 2019), textile, paper, adhesive (Ma et al., 2023), and biodegradable materials (Saranyadevi et al., 2026) industries. Also, due to its biodegradability, biocompatibility, and general availability, starch has emerged as an appealing alternative to petroleum-derived polymers in the development of sustainable materials. However, the functional performance of starch is largely determined by its molecular composition and structural organization, which differ amongst plant sources (Pfister & Zeeman, 2016).

Starch is largely made up of two glucose polymers, amylose and amylopectin, which appear in variable quantities depending on the plant species and cultivar. Amylose is a linear polymer made up of α-(1→4)-linked D-glucose units, while amylopectin is a highly branched polymer with α-(1→4) and α-(1→6) glycosidic connections (Thuan et al., 2026; Koksel etl al., 2023). The relative proportions of these two components have a substantial impact on starch's physicochemical and functional qualities, such as gelatinization, paste viscosity, retrogradation, gel formation, water absorption, swelling capacity, digestibility, and film-forming ability (Wang et al., 2024; Cornejo-Ramírez et al., 2018). As a result, estimating amylose content is an important part of starch characterization in both food and non-food applications.

Amylose content has been determined using a variety of analytical techniques, including colorimetric assays, chromatographic procedures, differential

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scanning calorimetry, and enzymatic analyses. The iodine-binding colorimetric method is one of the most extensively used due to its simplicity, speed, and low cost (Chen et al., 2025; Zhu et al., 2008). In this method, iodine molecules connect with the helical shape of amylose to generate a distinctive blue inclusion complex, whereas amylopectin is widely branched structure has a reduced iodine-binding affinity (Pesek et al., 2024; Pesek et al., 2022). The intensity of the blue value, is directly proportional to starch's iodine-binding ability and serves as an indirect estimate of its apparent amylose concentration. Blue value calculation has been widely used for comparative evaluation of starches from various botanical origins because it is simple and reproducible.

Tuber crops are important commercial sources of starch due to their high carbohydrate content and wide industrial application (Hundekari et al., 2023; Wang et al., 2020; Chandrasekara et al., 2016). *Ipomea batatas* (sweet potato) is an economically important root crop that is grown all over the world and is known for its high starch content and functional qualities (Laveriano-Santos et al., 2022; Bach et al., 2021; Jung et al., 2011). Similarly, an underutilized tropical tuber *Amorphophallus paeoniifolius* (elephant foot yam) is recognized for its high starch content and wide range of agroclimatic conditions tolerance. In addition to its usage as a food crop, starch has gained interest in food processing, medicine, biomaterials, and other value-added products (Panda et al., 2025; Srivastava et al., 2024; Suba et al., 2025; Hurkadale et al., 2012). These two Starches have different particle morphology, molecular structure, and amylose-to-amylopectin ratios, which can also affect their iodine-binding properties and functional performance.

A. paeoniifolius and *I. batatas* both has been studied as potential starch source, there is still a lack of comparison data regarding their starch yield and blue values under the same extraction and analytical circumstances. In addition to providing baseline data for choosing appropriate starch sources for applications where starch composition affects material performance, such comparative study is helpful in comprehending variations in iodine-binding capacity.

The current work used an iodine-spectrophotometric method to evaluate and compare the difference of blue value for starch extracted from *A. paeoniifolius* and *I. batatas*. It is anticipated that the results will shed light on the similarities and difference of starch qualities such as starch yield and iodine-binding capacity for indirect amylose estimation of these two tuber crops and their assessment as possible raw materials for medicine, industrial, culinary, and biodegradable material applications.

2. MATERIALS AND METHODOLOGY

Requirements: *I. batatas* and *A. paeoniifolius* tubers, 95% Ethanol, Sodium Hydroxide (NaOH), Acetic Acid, Iodine (I_2), Potassium Iodide (KI), Distilled Water (d.w.), Mixture, Sieves, Spectrophotometer, Cuvettes.

2.1. Starch extraction

Amorphophallus paeoniifolius and *Ipomoea batatas* tubers (500gm each) washed thoroughly under running tap water to remove adhering soil, dirt and other impurities. Chopped the cleaned tubers into small pieces and separately homogenized with distilled water at ratio of 1:2 (tuber:distilled water) using a mixture to obtain a uniform slurry.

Then slurry filtered through a sieve of 250 µm (ASTM) pore size. The filtrate was allowed to kept for 2-3hrs to settle starch. Later, the supernatant was decanted carefully, then extracted starch was washed for two to three times using distilled water to remove residual impurities and other non-starch components. The washed starch was again allowed to settle for an additional 1 h, after that supernatant was decanted.

The extracted purified starch dried in a hot air oven at 60°C for 3-4 hrs. The dried starch of *A. paeoniifolius* and *I. batatas* was ground into a fine powder. Starch yield is calculated using the Eq. (1) (Vithu et al., 2020). Dried starch stored separately in airtight containers to use for the further blue value estimation.

$$Starch\ yield = \frac{Weight\ of\ dried\ starch\ (gm.)}{Total\ weight\ of\ tubers\ taken (gm.)} \times 100 \qquad \text{Eq. (1)}$$

2.2. Blue value estimation

The blue value of the extracted starch was determined by slightly modifying an iodine-binding spectrophotometric method (Stawski 2008; Mohammadkhani et al., 1998; Samotus et al., 1993). For which took 0.1 g of starch sample into a test tube, that followed by the 1 mL of 95% ethanol and 9 mL of 1 M sodium hydroxide (NaOH) addition into it. Then it was heated in a boiling water bath for 10 min which helped starch to gelatinize. After heating it was kept to cool. Then starch solution was transferred to a 100 mL volumetric flask and diluted the prepared starch solution by adding distilled water to make it 100ml. An aliquot (2.5 mL) of the diluted starch solution was taken into a separate volumetric flask, which is followed by the 0.5 mL of 1 M acetic acid and 1 mL of stock iodine solution (0.2 g I and 2 g KI dissolved in 100 mL d.w.) addition into it. The volume was then adjusted to 50 mL by adding distilled water, and reaction mixture was after that allowed to stand for 20 min at room temperature to ensure complete development of the starch-iodine complex which led to the color change.

The absorbance of blue-colored resulting solution was measured at 620 nm using a UV-Visible spectrophotometer (Hitachi U-2900), where the stock iodine solution prepared without starch used as the blank. All the measurements performed in triplicates. Results are expressed as the mean ± standard deviation. The blue value was calculated using the following equation (2):

$$Blue\ value: \frac{OD\ at\ 620nm \times 4}{Concentration\ of\ starch\ (mg.dl^{-1})}$$

Eq. (2)

2.3. Statistical Analysis

Starch yield calculated as the percentage of dry starch obtained from the initial 500 g fresh tuber sample. All blue value measurements were performed in triplicate, and the results were expressed as mean ± standard deviation (SD). The mean and SD were calculated from the three analytical determinations for each starch sample.

3. RESULTS AND DISCUSSIONS

3.1. Starch yield of extracted starch

Starch was extracted from tubers of *Amorphophallus paeoniifolius* and *Ipomoea batatas* using above described aqueous extraction procedure. From total 500 g of fresh tuber material, 122 g of dry starch produced from *A. paeoniifolius*, which represent starch yield of 24.4%. while, 146 g of dry starch was produced from *I. batatas*, denotes 29.2% of starch yield (Table 1). Thus, in the present study under the same extraction conditions, *I. batatas* showed a higher starch yield in comparison of *A. paeoniifolius*. Difference is represented in Figure 1.

Starch	Fresh tuber weight (gm.)	Dry starch (gm.)	Starch yield (%)
A. paeoniifolius	500	122	24.4
I. batatas	500	146	29.2

Table 1. Starch yield from A. paeoniifolius and I. batatas

The difference in starch yield (Figure 1) could be attributed to variation in the native starch content and composition of the two plant sources (Rasul et al., 2026; Rashwan et al., 2024) Also, differences in starch extraction process during blending, filtration, sedimentation, washing, and decantation. Starch yield is also affected by factors such as cultivar, growing season, maturity, moisture content, particle disruption, solvent-to-sample ratio, and extraction efficiency (Puri et al., 2025; Vithu et al., 2020)

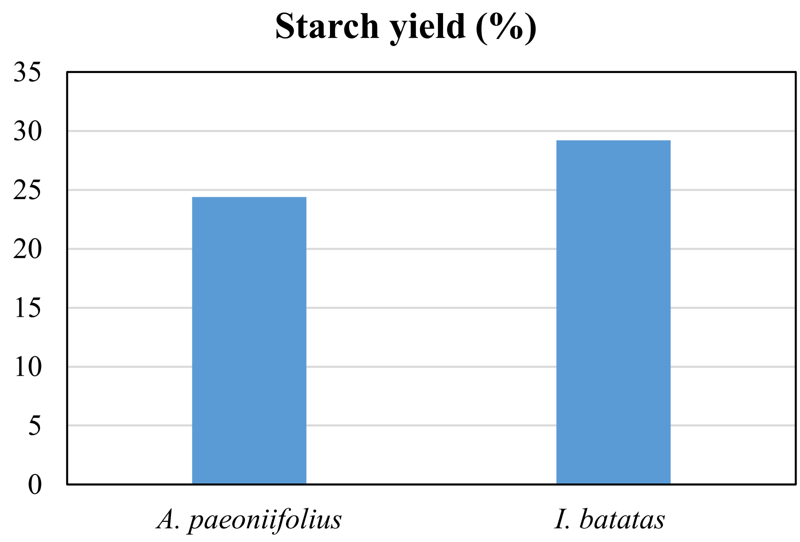

Figure 1. Starch yield (%) comparison of A. paeoniifolius and I. batatas

Blue value then evaluated for extracted starches using the iodine-spectrophotometric method. The absorbance of the starch-iodine complex measured at 620 nm wavelength. For *A. paeoniifolius* OD ranged from 0.461 to 0.640, while *I. batatas* OD ranged from 0.279 to 0.286 (Table 2). Based on the derived blue value equation, the corresponding blue values ranged for *A. paeoniifolius* is 0.3688, 0.4240, and 0.5116, with a mean of 0.4348 ± 0.0720. In contrast, *I. batatas* showed lower blue values of 0.2272, 0.2234, and 0.2282, with a mean value of 0.2263 ± 0.0025.

Starch	Replicate	OD_{620}	Blue Value
Amorphophallus paeoniifolius	1	0.460	0.3688
	2	0.530	0.4240
	3	0.640	0.5166
Mean ± SD			**0.435 ± 0.072**
Ipomea batatas	1	0.284	0.2272
	2	0.279	0.2234
	3	0.285	0.2282
Mean ± SD			**0.226 ± 0.003**

Table 2. Absorbance and blue value of starch-iodine complexes

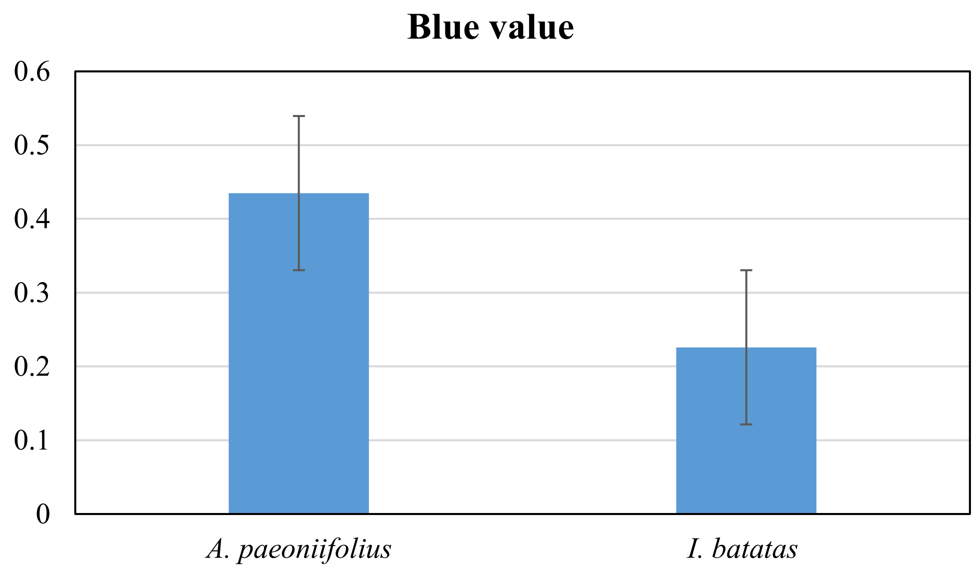

Figure 2. Blue value comparison of A. paeoniifolius and I. batatas starch

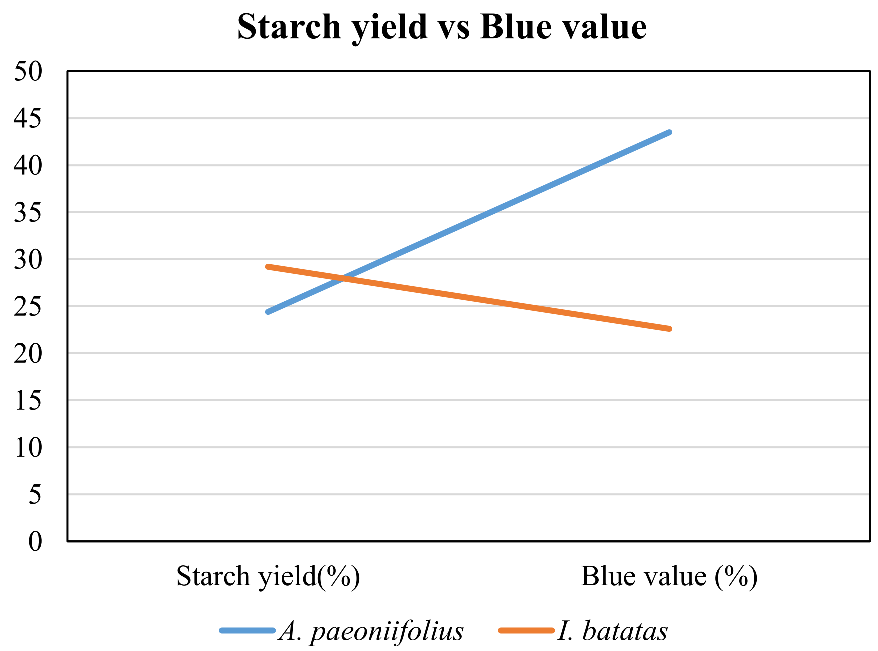

Figure 3. Starch yield vs blue value of A. paeoniifolius and I. batatas starch

A distinct difference in blue value was observed between the two starch sources (Figure 2). The mean blue value of *A. paeoniifolius* (0.4348) was approximately 1.92-fold that of *I. batatas* (0.2263), which is approximately 92.2% higher than *I. batatas*. The higher blue value indicates a greater iodine-binding capacity of the *A. paeoniifolius* starch compared with the *I. batatas* starch.

The blue value is based on the starch and iodine interaction and it is influenced by molecular characteristics of starch (Pesek et al., 2024). Helical structure in starch formed by amylose that accommodate iodine/polyiodide species, that produce the characteristic blue starch-iodine complex. Blue color is mainly due to amylose-iodine complex, because amylose complex absorbs iodine at the ~620 nm, while amylopectin iodine absorption affinity is very smaller, maximum at ~540nm, that develop reddish-brown color. Which clearly indicates the blue value evaluation result can be used indirectly to estimate the amylose content of the starch (Kim and

Jung, 2022; Pesek et al., 2022; Rani et al., 2021; Landolt 1886).

The greater blue value observed for *A. paeoniifolius* indicates that its starch possesses a greater iodine-binding capacity and greater amylose contribution compare to the starch obtained from *I. batatas*. Wickramasinghe et al. (2009) mentioned in his study that amylose related characteristics very according to species (within species or between species) based on the variety, growing conditions, tuber maturity etc. it is also previously observed by other researchers (Aryee et al., 2006; Thitipraphunkul et al., 2003; Noda et al., 2001; Moorthy et al., 1986). These observations support this study that differences in the blue value of two different species could be attributed to its origin, molecular structure and growing conditions.

Distinct observations seen in these results are starch yield and blue value developed opposite trends (Figure 3). *I. batatas* produced a higher quantity of starch content, with a yield of 29.2%, while *A. paeoniifolius* produced a lower quantity of starch which is 24.4%. However, the *A. paeoniifolius* starch showed higher blue value than *I. batatas*. It indicates that the quantity of starch yielded during extraction is not direct indication of its iodine-binding characteristics. Starch yield primarily represents the amount of starch isolated under the applied extraction conditions, whereas blue value provides information about the molecular characteristics and iodine-binding behaviour of the starch.

blue value difference between two different species may have functional significance because amylose-to-amylopectin characteristics influence several physicochemical properties of starch such as, gelatinization, pasting properties, retrogradation, swelling, and film-forming behaviour of starch (Wang et al., 2024; Kou et al., 2022). Therefore, the higher blue value of *A. paeoniifolius* suggests that this it is suitable for the application where higher amylose-associated functionality is desired but, such potential applications cannot be established solely on the basis of blue value, it also requires the additional physicochemical and functional characterization. Whereas *I. batatas* produce the higher starch content which makes them suitable for such application which require the higher starch yield.

The current study represents clear difference between *A. paeoniifolius* and *I. batatas* starch in terms of starch yield and iodine-binding characteristics. Although, *I. batatas* provided a higher starch yield, *A. paeoniifolius* showed a higher blue value. The contrasting trends demonstrate that starch yield and blue value represent different characteristics of starch and should be evaluated independently when selecting plant sources for further starch-based applications. The present findings provide preliminary comparative information of these two tuber starches and establish a base for further investigation of their amylose content, structural characteristics, thermal properties, pasting behaviour, and potential suitability for biodegradable material development.

CONCLUSION

The current study represents comparative blue-value profiles for the starch obtained from *Amorphophallus paeoniifolius* and *Ipomoea batatas*. Higher starch yield (29.2%) found in *I. batatas* than *A. paeoniifolius* (24.4%) processed under same extraction conditions, *A. paeoniifolius* starch exhibited higher blue value (0.435 ± 0.072) compared with *I. batatas* (0.226 ± 0.003). The contrasting results demonstrate that starch yield and iodine-binding characteristics are two distinct properties and that does not linearly align with each other, a higher starch yield does not necessarily correspond to a higher blue value. The blue values obtained can serve as baseline reference values for future comparative studies of these two starch sources when the same analytical procedure and conditions are followed. Future researchers can use these blue-value measurements of respective starches to evaluate their corresponding amylose characteristics with established standard amylose calibration curve without repeating the whole preliminary experiment and comparative analysis used here in this study.

Conflict of Interest

There is no conflict of interest between authors.

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